Biomonitoring of Metals in Children's Blood Using Existing Blood Lead Specimens

- Developing a New Biomonitoring Program -

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Developing a New Biomonitoring Program

- Collaborators -

- **Office of Public Health Emergency Preparedness** (administers BT Preparedness Funds)
- **Health and Environmental Testing Laboratory** (developing biomonitoring capacity as Level II Lab)
- **Environmental Public Health Tracking Program** (providing funds and toxicology and epidemiology staff)
- **Childhood Lead Poisoning Prevention Program** (responsible for blood lead surveillance program)

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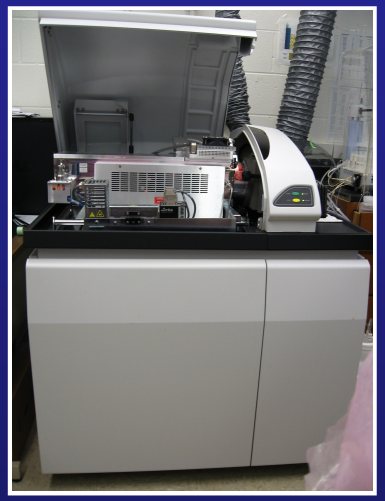
- Our General Approach -

- Make use of existing biological specimens already being submitted to HETL

- Make use of new biomonitoring capacity developed for chemical terrorism preparedness under "Full Use" principle.



ICP/DRC/MS

Developing a New Biomonitoring Program

- Major Activities -

- Identify biological specimens
- Identify objectives of biomonitoring program
- Identify target metals of interest
- Develop laboratory capacity and methods
- Address issues regarding informed consent
- Design a Pilot Study to assess feasibility
- Undertake Pilot Study

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- Identify Biological Specimens -

- State law requires all childhood blood lead testing to be performed at Maine's HETL – sample collection infrastructure already in place.
- About 16,000 samples per year; 50% of all 1-year olds and about 25% of 2-year olds.
- About 40% of samples are initial venous draws - adequate residual blood volume and reduced potential for contamination.

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- Why Metals? -

- HETL was developing capacity to analyze urine samples for multiple metals using ICP/DRC/MS
- Potential for shifting blood leads from GFAA single-metal analysis to ICP/DRC/MS for multiple metal analysis (sustainability issue)
- Emerging literature on effects from exposure to metal mixtures

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- Objectives of our biomonitoring program -

- Determine whether selected metals are getting into children's bodies and the levels of these chemicals in blood;
- Determine whether levels are higher for specific age groups, sex, or regions;
- Establish reference ranges that determine whether a person has unusually high blood levels of a contaminant
- Track, over time, trends in the levels of exposure of a population to these metals
- Assess effectiveness of public health efforts to reduce exposure of populations to specific contaminants

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- Implementation Plan -

- **PHASE 1 – planning and building capacity / components**
- **PHASE 2 – pilot study to assess feasibility and obtain data on reference ranges**
- **PHASE 3 – develop and ongoing sustainable program**

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- Identifying Target Metals of Interest -

- **Considered known environmental hazards in Maine**
- **Considered literature on measuring metals in blood**
- **Considered science on potential metal interactions**
- **Considered existing laboratory methods**
- **FINAL LIST: Pb, Cd, Hg, U, Sb, Sn, As, Se, Mn**

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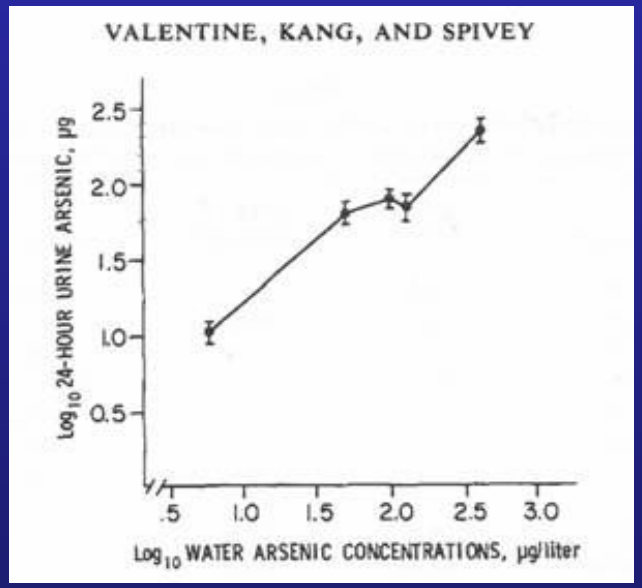
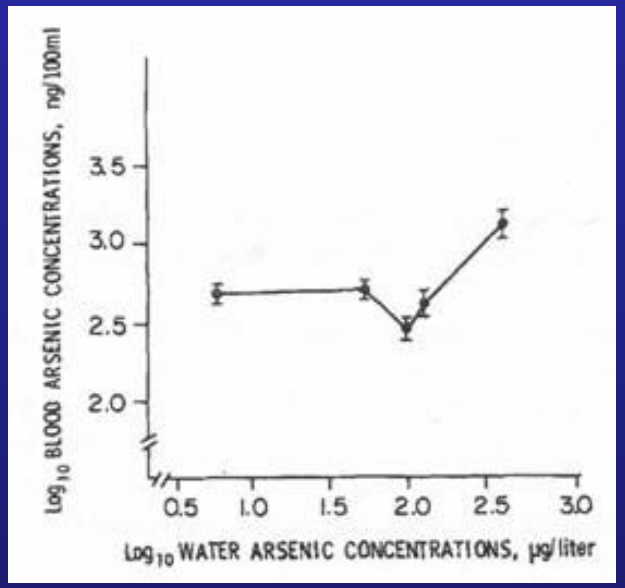
- Measuring arsenic in blood is problematic -

- Arsenic has a very short half-life in blood; urine preferred biological matrix





Source: Valentine JL et al., *Environmental Research*, Vol.20:22-32 (1979)

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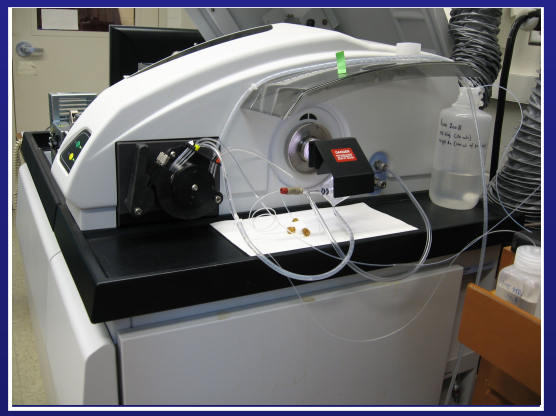
- Develop Laboratory Capacity -

- BT Preparedness funds used to build chemical terrorism preparedness-related biomonitoring capacity
- CDC training and proficiency testing for metals in urine
- HETL developed method for Pb, Hg, Cd, Sb, Sn using ICP/MS in standard metals mode and As, Se, and Mn using DRC mode
- Maine EPHT purchased additional sample introduction systems to allow for rapid change between urine and blood samples



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- Method for Determination of Metals in Blood -

- Blood method for Cd, Hg, Pb, Tn, Sb, U based on original method for Cd, Hg, Pb in blood prepared by NYDOH (C. Palmer).
- Blood method for As, Se, Mn using DRC mode based a method created for urine matrix by CDC.
- Method Detection Limits:

	Standard Mode Metals					DRC Mode Metals		
	Antimony Sb	Cadmium Cd	Mercury Hg	Tin Sn	Uranium U	Arsenic As	Manganese Mn	Selenium Se
Detection Limit (ug/L)	0.05	0.01	0.02	0.03	0.002	0.18	0.18	0.18

Contact: James.Curlett@Maine.gov

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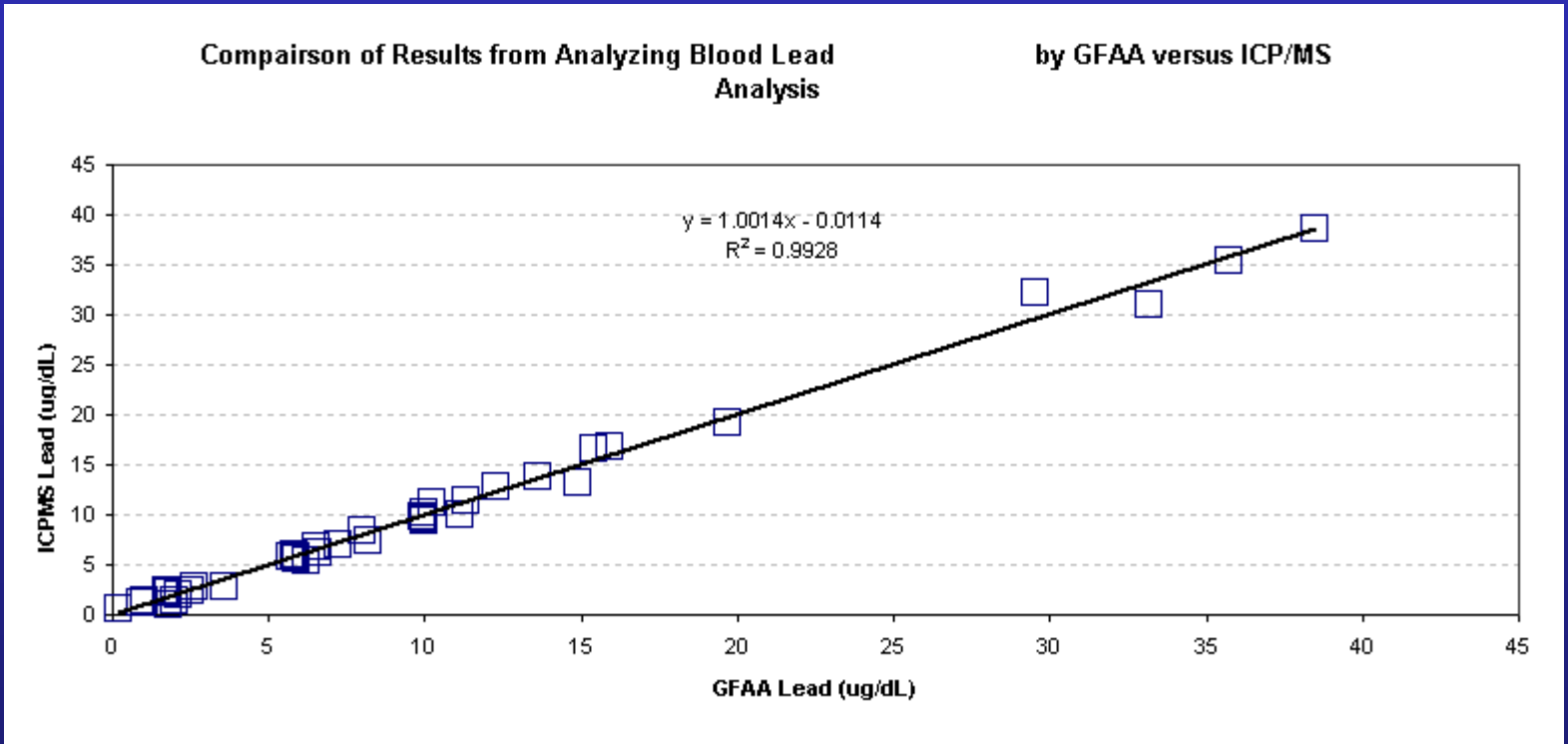
– Comparison of ICP/DRC/MS and GFAA –



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- Is Consent required if samples de-identified? -

- No rules governing use of residual blood from specimens submitted for lead analysis
- We do have rules governing use of residual filter paper specimens from new born screening tests – these rules allow use of de-identified specimens without consent
- There are ethical issues and potential barriers with obtaining consent at this time:

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- Informed Consent -

- For several target analytes, no established reference ranges and/or clinical action levels
- For some metals (e.g., arsenic), unclear if blood is a useful biological matrix for monitoring exposure
- Without pilot data, may be difficult to obtain cooperation of health care providers in obtaining consent for an expanded metal analysis
- We are proposing to use de-identified specimens without consent. IRB will determine if this is appropriate.

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- PHASE 2 Pilot Study -

- Target Sample Size: N = 1400, with goal of 120 children in each age and sex cohort for 1 through 6 years old.
- Samples collected on monthly basis using residual blood from venous specimens submitted for lead analysis
- Samples de-identified, except for year of age, sex, and region of state.
- Samples stored at –70°C for batch analyses
- Samples analyzed for all method metals except lead
- Sample collection scheduled to begin Fall 06, following IRB review of protocol

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- Next Steps -

- Protocol to be submitted to IRB in Fall 06
- Collect samples for 1-year
- Results - late 07
- Evaluate and plan for ongoing system with identifiers